

**What Is Claimed Is:**

1        1. A method for I/Q mismatch calibration of a receiver  
2        having an I/Q correction module which performs  
3         $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$  where  $x_i[n]$  and  $x_o[n]$  respectively  
4        represent the input and output signal of the I/Q correction  
5        module, the superscript \* refers to a complex conjugate, and  $A_p$   
6        and  $B_p$  are correction parameters, comprising the following  
7        steps:

8            generating a test signal  $x(t)$  containing a single tone  
9            waveform with frequency of  $(f_c + f_T)$  Hz, where  $f_c$  and  
10           $f_T$  are real numbers;  
11          applying I/Q demodulation to reduce the central frequency  
12          of the test signal  $x(t)$  by  $f_c$  Hz and output a  
13          demodulated signal  $x_{dem}(t)$ ;  
14          converting the demodulated signal  $x_{dem}(t)$  to a digital  
15          signal  $x_{dem}[n]$ ;  
16          obtaining measures  $U_1$  and  $U_2$  of the digital signal  $x_{dem}[n]$   
17          where  $U_1$  and  $U_2$  are values indicative of the frequency  
18          response of  $x_{dem}(t)$  at frequency  $+f_T$  Hz and  $-f_T$  Hz,  
19          respectively; and  
20          calculating the set of the correction parameters  $A_p$  and  $B_p$   
21          for the I/Q correction module based on the measures  
22           $U_1$  and  $U_2$ .

1        2. The method for I/Q mismatch calibration of a receiver  
2        as claimed in claim 1, the measure  $U_1$  and  $U_2$  are obtained from  
3        the coefficients of the Fourier transformation of the  $x_{dem}[n]$   
4        corresponding to the frequency  $+f_T$  Hz and  $-f_T$  Hz.

1       3. The method for I/Q mismatch calibration of a receiver  
2 as claimed in claim 1, wherein the test signal  
3  $x(t) = \cos(2\pi(f_c + f_T)t)$ .

1       4. The method for I/Q mismatch calibration of a receiver  
2 as claimed in claim 1, wherein the set of correction parameters  
3  $(A_p, B_p)$  are obtained by

4

$$\begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5 where  $\alpha$ ,  $R$ , and  $S$  are obtained based on  $U_1$  and  $U_2$ .

1       5. The method for I/Q mismatch calibration of a receiver  
2 as claimed in claim 4, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained based  
3 on

4

$$H = \text{real}(U_1 \cdot U_2),$$

5

$$I = \text{imag}(U_1 \cdot U_2),$$

6 and

7

$$G = |U_1|^2 + |U_2|^2.$$

1       6. The method for I/Q mismatch calibration of a receiver  
2 as claimed in claim 4.1, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained by

3

$$\alpha = \frac{H}{\kappa},$$

4 where

5

$$\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2},$$

6 and

7

$$R = \sqrt{\frac{1+P}{2}},$$

8

$$S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}},$$

9

where

10

$$Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)},$$

11

$$P = \sqrt{1 - \left( \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2}.$$

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2. The method for I/Q mismatch calibration of a receiver  
3 as claimed in claim 4, wherein the set of correction parameters  
4  $(A_p, B_p)$  is further normalized  
5 such that the power of the output signal of the I/Q correction  
6 module equals to that of the input signal of the I/Q correction  
module.

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2. An apparatus for I/Q mismatch calibration of a  
3 receiver having an I/Q correction module which performs  
4  $x_o[n] = A_p \cdot x_i[n] + B_p \cdot x_i^*[n]$  where  $x_i[n]$  and  $x_o[n]$  respectively  
5 represent the input and output signal of the I/Q correction  
6 module, the superscript \* refers to a complex conjugate, and  $A_p$   
and  $B_p$  are correction parameters, comprising:

7

a signal generator for generating a test signal  $x(t)$  which  
contains a single tone waveform with frequency of  
 $(f_c + f_T)$  Hz, where  $f_c$  and  $f_T$  are real numbers;

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a demodulator for applying I/Q demodulation to reduce the  
central frequency of the test signal  $x(t)$  by  $f_c$  Hz  
and outputting a demodulated signal  $x_{dem}(t)$ ;

13       A/D converters for converting the demodulated signal  $x_{dem}(t)$   
14            to a digital signal  $x_{dem}[n]$ ;  
15        a dual-tone correlator for obtaining measures  $U_1$  and  $U_2$  of  
16            the digital signal  $x_{dem}[n]$  output from the I/Q  
17            correction module where  $U_1$  and  $U_2$  are values  
18            indicative of the frequency response of  $x_{dem}(t)$  at  
19            frequency  $+f_T$  Hz and  $-f_T$  Hz, respectively; and  
20        a processor for obtaining the set of the correction  
21            parameters  $A_p$  and  $B_p$  according to the measures  $U_1$  and  
22             $U_2$ .

1       9. The apparatus for I/Q mismatch calibration of a  
2        receiver as claimed in claim 8, the measure  $U_1$  and  $U_2$  are obtained  
3        from the coefficients of the Fourier transformation of the  
4         $x_{dem}[n]$  corresponding to the frequency  $+f_T$  Hz and  $-f_T$  Hz.

1       10. The apparatus for I/Q mismatch calibration of a  
2        receiver as claimed in claim 8, wherein the test signal  
3         $x(t) = \cos(2\pi(f_c + f_T))$ .

1       11. The apparatus for I/Q mismatch calibration of a  
2        receiver as claimed in claim 8, wherein the set of correction  
3        parameters  $(A_p, B_p)$  are obtained by

$$\begin{cases} A_p = R + j\alpha S \\ B_p = -\alpha R - jS \end{cases}$$

5       where  $\alpha$ ,  $R$ , and  $S$  are obtained based on  $U_1$  and  $U_2$ .

1       12. The apparatus for I/Q mismatch calibration of a  
2        receiver as claimed in claim 11, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained  
3        based on

$$H = \text{real}(U_1 \cdot U_2),$$

5

$$I = \text{imag}(U_1 \cdot U_2) ,$$

6 and

7  $G = |U_1|^2 + |U_2|^2 .$

1 13. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 12, wherein  $\alpha$ ,  $R$ , and  $S$  are obtained  
3 by

4  $\alpha = \frac{H}{\kappa} ,$

5 where

6  $\kappa = \frac{G + \sqrt{G^2 - 4H^2}}{2} ,$

7 and

8  $R = \sqrt{\frac{1+P}{2}} ,$

9  $S = \sqrt{\frac{Q}{2 \cdot \sqrt{\frac{1+P}{2}}}} ,$

10 where

11  $Q = \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} ,$

12  $P = \sqrt{1 - \left( \frac{2 \cdot I}{\kappa \cdot (1 - \alpha^2)} \right)^2} .$

1 14. The apparatus for I/Q mismatch calibration of a  
2 receiver as claimed in claim 11, wherein the set of correction  
3 parameters  $(A_p, B_p)$  is further normalized such that the power of  
4 the output signal of the I/Q correction module equals to that  
5 of the input signal of the I/Q correction module.